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Carbon Capture and Sequestration: Lessons about Property From Law and Economics

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Overview

- Stylized Operational Observations
- Basic Theorems in Economics
- "Carbon Capture and Sequestraton is Like…"
- Application to Carbon Capture and Sequestration

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About Economists

- Fundamental bias toward private allocation of resources
- Bias is consistent with recent trends in environmental policy

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Definition of Economist

One who observes a phenomenon in the real world and thinks, "That is interesting, but will it work in theory?"

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Stylized Operational Observations

- What happens to the CO_2?
  - It fills pores spaces at depths of 800 to 3000 meters, often in saline aquifers, generally underlying private property
- What does the plume of a 5 MMT/yr injection look like?
  - CO_2 rises vertically and migrates laterally within reservoir, eventually covering as much as 1000 square miles.

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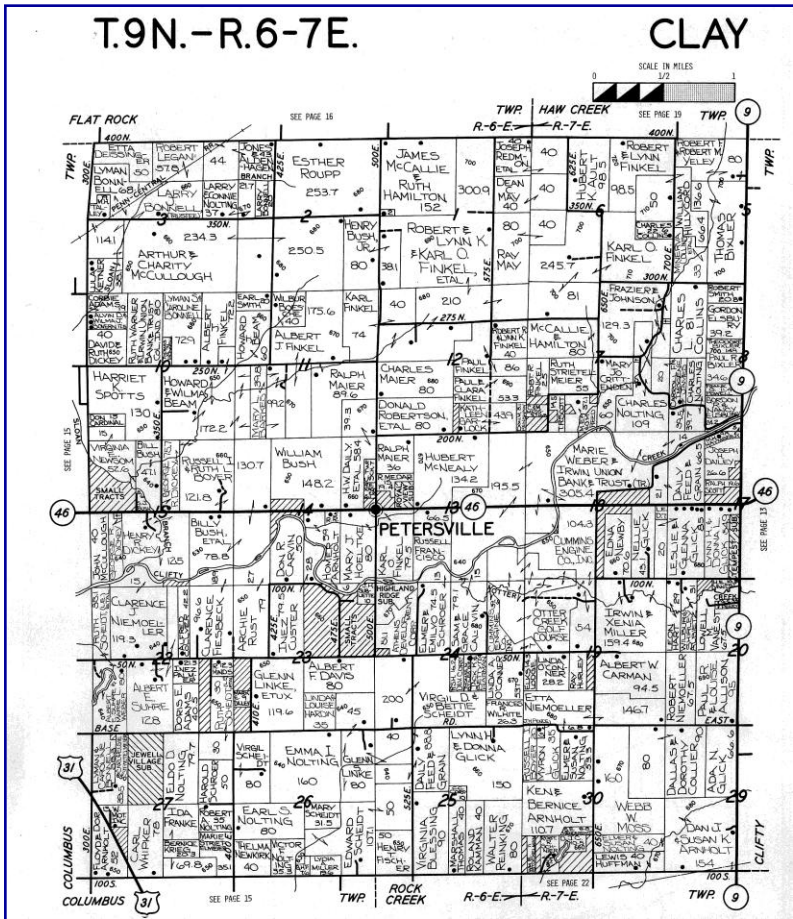
Stylized Operational Observations

- How many land holdings will overlay a typical plume?
  - Potentially thousands
- Can we predict where the CO_2 will migrate?
  - In heterogeneous reservoirs there will be significant uncertainty regarding the ultimate path and mode in which the CO_2 will exist in the reservoir



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Stylized Operational Observations

- How will those land holdings be affected?
  - In addition to subsurface flows, the CCS operation will require surface access to test the mechanical integrity of abandoned oil and gas wells and possibly to install monitoring instruments and wells

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Moving from Operations to Policy

- So CCS involves deep injection into a largely unused reservoir, the plume of which could spread over large areas, affecting potentially thousands of landowners, following an uncertain path, with potential impacts on both the surface and subsurface.

- So how do we deal with property rights? Can we let private parties sort it out? Will they find an efficient outcome?

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First Fundamental Theorem of Welfare Economics

The prices that arise from a competitive economy with self-interested traders will lead to an efficient allocation of resources.

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First Fundamental Theorem of Welfare Economics

The prices that arise from a competitive economy with self-interested traders will lead to an efficient allocation of resources.

Competitive economy requires:

1. Many buyers and sellers (no market power or monopoly)
2. Perfect information
3. Mobile resources (no barrier to entry and exit)
4. Homogenous goods (anonymity of supplier)

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Coase Theorem

When there are externalities, parties will negotiate to an efficient outcome provided that the initial property rights are well-defined, there are zero transaction costs, and there is perfect information.

Moreover, the efficiency of the outcome is independent of the initial allocation of property rights.

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Coase Theorem

When there are externalities parties will negotiate to an efficient outcome provided that the initial property rights are well-defined, there are zero transaction costs, and there is perfect information.

Moreover, the efficiency of the outcome is independent of the initial allocation of property rights.

Requirements:

Well-defined property rights
Perfect information
Low-transaction costs

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Implications for the Role of Government in CCS

- Defining property rights
- Generating and disseminating information
- Lowering transactions costs

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Defining Property Rights

- Pore space ownership
- Delimiting rights of pore space ownership (c.f., Wyoming HB89)
  - Trespass
  - Negative rule of capture
  - "Heaven to hell" rule
- Ownership of CO_2

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Generating and Disseminating Information

- Geoscience
  - Subsurface characterization
  - Chemical reactions
- Risk
  - Surface leakage
  - Groundwater quality effects
  - Regional impacts (e.g., seismicity and heaving)
  - Human health
  - Sterilization of resources
- Alternative uses of subsurface resources

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Lowering Transactions Costs

- Coordination costs
  - Search for parties
  - Negotiation
- Strategic behavior
  - Asymmetries of information
  - Hold out and gaming

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Lowering Transactions Costs: Coordination Costs

- Search for parties
  - Maintaining complete and accessible real property records
  - Establishing "good faith" or due diligence standards
- Negotiation
  - Providing disinterested facilitators
  - Establishing "good faith" negotiation standards
  - Educating parties
    - General negotiation training
    - Case studies
    - Market information

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Lowering Transactions Costs: Strategic Behavior

- Asymmetries of information
  - Technical information
    - Disclosure regulations
    - State geological surveys
  - Market information
    - Results of other negotiations
    - Profitability of CCS operators

- Hold out
  - Establishing good faith bargaining standards

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CCS is like…

Oil and natural gas extraction, because…

- Both involve using subsurface resources (hydrocarbons and pore space)
- Efficient use of the resources requires cooperation among land owners

But not exactly, because…

- Oil and natural gas involve extraction of an inherently valuable resource as private property
- CCS involves injection of CO_2 to protect public welfare

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CCS is like…

Enhanced oil recovery, because…

- Both can involve injection of CO_2 into pore space
- Both require coordination among landowners

But not exactly, because…

- EOR is generally embedded in oil lease contracts
- The scale of EOR and CCS with respect to the volumes required are different

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CCS is like…

Natural gas storage, because…

- Both involve injection and storage of a gas that can migrate
- Both are for "the public good"

But not exactly, because…

- Natural gas storage is generally conducted in existing production fields with existing contracts
- CCS fields might be an order of magnitude greater in size than natural gas storage fields
- CCS is permanent storage

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CCS is like…

Groundwater extraction, because…

- Both implicate the use of aquifers and groundwater rights
- Both raise issues of private versus public ownership of groundwater

But not exactly, because…

- CCS implicates low-value saline aquifers as storage whereas groundwater extraction implicates high-value freshwater uses.
- Saline aquifers are much deeper and CCS does not involve extraction.

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CCS is like…

Hazardous waste injection, because…

- Both involve deep injection of a substance for long-term confinement
- Migration of injectate is a concern for both

But not exactly, because…

- CO_2 does not meet the definition of hazardous waste
- The quantities of CO_2 and potential for migration are much greater

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CCS is like…

Fresh water storage, because…

- Both involve injection and storage
- Both serve a public purpose

But not exactly, because…

- Water is a resource occurring naturally in the ground where CO_2 is a human-produced substance that is introduced
- Water storage may be temporary where CO_2 injection is intended to be permanent

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CCS is like…

Flying an airplane, because

- Both involve potential trespass at substantial distances from the surface
- Both are technologies developed after property regimes were developed
- Both could damage property, but generally do not

But not exactly, because

- Flying over is not permanent
- Air flight was long established before the suit for trespass was brought

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The Use of Analogies

- The analogies suggest tools, strategies and concepts for dealing with the conflict between private property and public welfare.
- The law that pertains to each analogy can not be directly applied to CCS

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Forced Pooling (Oil Extraction)

Eminent domain (Natural gas storage)

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Eminent domain (Natural gas storage)

Unitization (EOR)

Servitude (Freshwater storage)

Requirement of actual damages (Hazardous Waste)

Limitation on extent of property (Air flight)

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→ Statutory Law

Servitude (Freshwater storage)
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Thank you!

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Limited Role for Government?

- Perhaps, if property rights can be defined and transactions costs can be reduced to a manageable level.

- In some cases, particularly with large numbers of parties and complex systems, transactions costs dominate – then government imposition of outcomes may be more efficient (c.f., UIC).

Conclusions

- State governments will need to carefully define their role in the CCS environment

- If the government wants to follow a market-driven approach, then the states' primary responsibilities will be to
  - Clarify property rights
  - Reduce transactions costs
  - Produce information

- There are some cases where the transactions costs are just too high, particularly in issues of broad public safety, when even a market-oriented policy maker will have to allow for state control.